

WHAT IS CLAIMED IS:

1. A method for determining a surface voltage of an insulating film, wherein a wafer comprises the insulating film formed on a substrate, the method comprising:

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depositing a charge on an upper surface of the insulating film;

measuring a current to the wafer during said depositing; and

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determining the surface voltage of the insulating film from the current.

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2. The method of claim 1, wherein said determining comprises determining an accumulated voltage as a function of the current, wherein the function is determined by calibration of a charge deposition system used for said depositing, and determining the surface voltage from the accumulated voltage and a reference voltage of said depositing.

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3. The method of claim 1, further comprising detecting the charge on a reference sensor during said depositing and measuring a bias voltage of the reference sensor, wherein the surface voltage is approximately equal to the bias voltage of the reference sensor when the current to the reference sensor is approximately equal to the current to the wafer.

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4. The method of claim 1, wherein said depositing comprises depositing the charge until the current to the wafer is substantially constant, wherein the substantially constant current is approximately equal to a leakage current of the insulating film.

5. The method of claim 1, wherein said depositing comprises depositing the charge over time, the method further comprising determining charge build up on the upper surface by integrating the current over the time.

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6. The method of claim 1, further comprising illuminating the upper surface of the insulating film during said measuring, and determining a band-bending voltage at an interface between the insulating film and the substrate as a difference between the surface voltage and a surface voltage of the insulating film determined without said illuminating.

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7. The method of claim 1, further comprising illuminating the upper surface of the insulating film with an alternating current modulated light source during said depositing and said measuring, and determining a direct current component and an alternating current component of the current at the frequency of the light source, wherein said determining comprises determining the surface voltage for the direct current and alternating current components of the current.

10 8. The method of claim 1, further comprising altering a control voltage after said measuring and repeating said depositing, said measuring, and said determining.

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9. The method of claim 1, wherein said depositing comprises exposing the wafer to a plasma.

10 20 10. The method of claim 1, further comprising determining a parameter representing an electrical property of the insulating film from the surface voltage.

11. The method of claim 1, further comprising determining a parameter representing an electrical property of the insulating film from the surface voltage and altering a parameter of a process tool in response to the electrical property using a feedback control technique.

12. The method of claim 1, further comprising determining a parameter representing an electrical property of the insulating film from the surface voltage and altering a parameter of a process tool in response to the electrical property using a feedforward control technique.

13. The method of claim 1, further comprising performing the method during a semiconductor fabrication process.

14. A method, comprising:

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measuring a first current to a wafer during deposition of a first charge on a surface of the wafer, wherein the wafer comprises an insulating film formed on a substrate;

10 determining a first surface voltage of the insulating film from the first current;

measuring a second current to the wafer after a high current mode deposition of a second charge on the surface of the wafer; and

15 determining a second surface voltage of the insulating film from the second current, wherein the first and second surface voltages are determined at approximately the same location on the insulating film.

16. The method of claim 14, further comprising repeating said measuring the second current and said determining the second surface voltage until a Q-V sweep is measured.

17. The method of claim 14, wherein said measuring the first current comprises measuring the first current while altering a control voltage, and wherein said determining the first surface voltage comprises determining a current turn-on point from the first current vs. the control voltage, and determining the first surface voltage from the value of the first current at the current turn-on point.

18. The method of claim 14, wherein the first charge and the second charge are deposited with the same charge deposition system.

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18. The method of claim 14, wherein the first charge and the second charge are deposited with different charge deposition systems.

19. A method for determining charge vs. voltage data for an insulating film, wherein a
5 wafer comprises the insulating film formed on a substrate, the method comprising:

depositing a charge on an upper surface of the insulating film;

10 altering a control voltage during said depositing such that a current to the wafer is substantially constant over time; and

15 determining a voltage of the insulating film as a function of the charge deposited on the insulating film, wherein the voltage is determined from the control voltage and the current, and wherein the charge deposited on the insulating film is determined from the current and the time.

20. The method of claim 19, wherein the control voltage is a reference voltage of the charge deposition system or a reference voltage of the wafer.

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